

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Applicant(s): Michael M. Iwatake (et al.) Examiner: Anh D. Mai
Serial No.: 10/711,298 Group Art Unit: 2814
Filed: September 9, 2004 Attorney Docket No: FIS920040156
Title: VIA CONTACT STRUCTURE HAVING DUAL SILICIDE LAYERS

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**RESPONSE TO
ORDER RETURNING UNDOCKETED APPEAL TO EXAMINER**

Sir:

This paper is submitted in response to an Order Returning Undocketed Appeal To Examiner ("Order") mailed May 31, 2007 by the United States Patent and Trademark Office in connection with the above-identified Application.

Appellants are submitting a revised Appeal Brief that fully addresses the concerns of the Order. In particular, this revised Appeal Brief contains items under the following headings and in the order set forth below, as required under 37 C.F.R. § 41.37:

- I. Real party in interest
- II. Related appeals and interferences
- III. Status of claims
- IV. Status of amendments
- V. Summary of claimed subject matter

- VI. Grounds of rejection to be reviewed on appeal
- VII. Arguments
- VIII. Claims appendix
- IX. Evidence appendix
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No fees are believed to be due in connection with this communication. However if there are any such fees due, please charge any such fees to the deposit account 09-0458.

Respectfully submitted,

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Dated: June 7, 2007

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I. Real party in interest

International Business Machines Corporation is the real party in interest in this appeal.

II. Related appeals and interferences

There are no related appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in this appeal.

III. Status of claims

The claims in the Application are: Claims 1-10, totaling 10 claims.

Claims 1-10 are rejected.

Claims 1-10 are on appeal pursuant to Notice of Appeal filed on July 7, 2006.

IV. Status of amendments

No amendments were made following the Final Office Action mailed on April 13, 2006.

Appellants made a response, on May 30, 2006, to the Final Office Action and amended the title of the application to more particularly descriptive of the present invention. However, no amendments were made to the claims currently under appeal.

V. Summary of claimed subject matter

The claimed invention relates to a via contact structure (e.g., FIG. 1) having a via contact (e.g., 100 of FIG. 1) to a diffusion region (e.g., 102 of FIG. 1) at a top surface (e.g., 101 of FIG. 1) of a substrate. The via contact structure includes 1) a first layer (e.g., 103 of FIG. 1) consisting essentially of a silicide of a first metal in contact with the diffusion region at the top surface (p.8, lines 14-15); 2) a dielectric region (e.g., 112 of FIG. 1) overlying the first layer (p.8, lines 13-14), the dielectric region having an outer

surface (e.g., 120 of FIG. 1) and an opening (e.g., 110 of FIGS. 1&4) extending from the outer surface through the first layer to the top surface (FIGS. 1&4, p.8, lines 9-12) of the substrate; 3) a second layer (e.g., 106 of FIGS. 1&5-7) lining the opening and contacting the top surface in the opening (p.14, lines 19-20), the second layer including a second metal lining a sidewall of the opening (p.14, lines 19-20) and a silicide of the second metal self-aligned to the top surface in the opening (p.17, lines 4-5); 4) a diffusion barrier layer (e.g., 122 of FIGS. 1&6-7) overlying the second layer within the opening (p.16, lines 1-2); and 5) a third layer (e.g., 124 of FIGS. 1&7) including a third metal overlying the diffusion barrier layer and filling the opening (p.16, lines 12-14).

VI. Grounds of rejection to be reviewed on appeal

The issues presented in this appeal are:

- whether claims 1-5 and 8 are anticipated by Chung et al. (US. 5,094,981);
- whether claims 6, 7, 9 and 10 are obvious over Chung et al. in view of Ohsaki (JP. Patent No. 08-107087); and
- whether claims 4 and 5 are indefinite.

VII. Arguments

In the Office Action, the Examiner erroneously rejected claims 1-5 and 8 under 35 U.S.C. §102(b), as being anticipated by Chung et al. (US 5,094,981) ("Chung").

In rejecting claim 1, the Examiner alleges that Chung describes a via contact structure having a first layer (42c) and a dielectric region (32) overlying the first layer and having an outer surface and an opening. However, after failing to assert that Chung teaches the opening extending from the outer surface "through said first layer to said top surface of said substrate", as specifically required by claim 1, the Examiner contends that claim element of "an opening extending from said outer surface through said first layer to said top surface of said substrate" (the "expression") is a product-by-process limitation and therefore is not given patentable weight.

Appellants' arguments are as follows:

The Examiner's allegation that the "expression" is a product-by-process limitation is totally baseless without merit. The "expression" clearly describes how a final structure of the present invention, according to one embodiment, may look like. That is, the final structure of the present invention may have an opening, which is part of the structure and is described by the "expression", wherein a via contact, according to one embodiment of the present invention, is formed. Appellants assert that in no way may the "expression" be interpreted as describing a process or a method of making the opening, or a process or a method of making the structure of the present invention.

Despite the above allegation, the Examiner subsequently contends that Chung describes a second layer lining the opening and contacting the top surface (of the substrate) in the opening, even though the Examiner fails to show that Chung discloses an opening that extends to the top surface of the substrate. As is clearly shown in FIG. 2d which is specifically cited by the Examiner, the opening of dielectric region (32) does not even extend through layer (42c) to the top surface of substrate (10). Therefore, it is technically impossible for liner (34) to contact the top surface of substrate (10) in the opening of dielectric region (32). In other words, the allegation made by the Examiner, that the second layer contacting the top surface (of the substrate) in the opening, is again baseless and without merit.

In the Office Action, the Examiner erroneously rejected claims 2-10 as either anticipated by or obvious over prior art references of record. The fact is that claims 2-10 depend directly or indirectly from claim 1, and thus are patentable at least for the reasons as described above with regard to claim 1.

In the Office Action, the Examiner erroneously rejected claims 4 and 5 under 35 U.S.C. §112, second paragraph, as being indefinite. The Examiner alleges that the first metal is a silicide and the sidewall portion of the second metal is a metal and therefore they are not the same. The Examiner also alleges that because the first metal and the

bottom portion of the second metal are silicide, they do not consist of essentially cobalt or titanium.

Appellants' arguments are as follows:

The Examiner's statements that "the first metal is a silicide" and "the first metal and the bottom portion of the second metal are silicide" are technically incorrect and have no merit. The fact is that a metal is a metal and not a silicide. In other words, a metal is different from a silicide. Claiming a metal is a silicide is simply baseless.

On the other hand, a silicide may be formed from metals and silicon and therefore may comprise of metals. A person of ordinary skill will understand that a first metal or a first metal that forms a first silicide may be the same or different from a second metal or a second metal that forms a second silicide.

Claims 4 and 5 depend from claim 1, therefore the first metal (that forms the silicide of the first layer) and the second metal (that forms a sidewall portion and the silicide of a bottom portion of the second layer) may be the same. In addition, the first and/or second metal may consist essentially of cobalt, titanium, or any other metals. In other words, it will be baseless to argue that the first and second metals may not be the same and may not consist essentially of cobalt, titanium, or any other metals.

VIII. Claims appendix

The text of claims 1-10 involved in this Appeal are:

1. A via contact structure having a via contact to a diffusion region at a top surface of a substrate, the via contact structure comprising:

a first layer consisting essentially of a silicide of a first metal in contact with said diffusion region at said top surface;

a dielectric region overlying said first layer, said dielectric region having an outer surface and an opening extending from said outer surface through said first layer to said top surface of said substrate;

a second layer lining said opening and contacting said top surface in said opening, said second layer including a second metal lining a sidewall of said opening and a silicide of said second metal self-aligned to said top surface in said opening;

a diffusion barrier layer overlying said second layer within said opening; and

a third layer including a third metal overlying said diffusion barrier layer and filling said opening.

2. The via contact structure as claimed in claim 1, wherein said first metal is selected from the group consisting of cobalt (Co), molybdenum (Mo), niobium (Nb), nickel (Ni), palladium (Pd), platinum (Pt), tantalum (Ta), titanium (Ti), vanadium (V) and tungsten (W).

3. The via contact structure as claimed in claim 2, wherein said second metal is selected from the group consisting of titanium (Ti), nickel (Ni), platinum (Pt), cobalt (Co), tantalum (Ta), and tungsten (W).
4. The via contact structure as claimed in claim 3, wherein said first metal and said second metal are the same.
5. The via contact structure as claimed in claim 3, wherein said first metal consists essentially of cobalt and said second metal consists essentially of titanium.
6. The via contact structure as claimed in claim 1, wherein said diffusion barrier layer includes a metal nitride.
7. The via contact structure as claimed in claim 6, wherein said metal nitride includes titanium nitride (TiN).
8. The via contact structure as claimed in claim 1, wherein said third metal includes tungsten (W).

9. The via contact structure as claimed in claim 1, wherein said opening has a width of about 250 nm or less and a height-to-width aspect ratio greater than one.

10. The via contact structure as claimed in claim 9, wherein said aspect ratio value is about two.

IX. Evidence appendix

No evidence was submitted pursuant 37 C.F.R. § 1.130, 1.131, or 1.132, and no evidence was entered separately by the Examiner.

X. Related proceedings appendix

None